Econ 219B
Psychology and Economics: Applications
(Lecture 2)

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Outline

1. Defaults and 401(k)s: The Facts II
2. Default Effects and Present Bias
3. Default Effects: Alternative Explanations
4. Present Bias and Consumption
5. Investment Goods: Homeworks

1 Defaults and 401(k)s: The Facts II

- Summary of Madrian and Shea (2001)
  - OLD and NEW cohorts invest very differently one year after initial hire
    * Fact 1. **Fact 1. Majority of investors follow Default Plan**
    * Fact 1a. Applies to participation (yes/no)
    * Fact 1b. Applies also to contribution level and allocation
  - (Less commonly cited) WINDOW cohort resembles OLD cohort
    * Fact 2. ‘**Suggested choice’ not very attractive unless default**

- BUT: Default effects not informative of optimal saving plans.
  - Is OLD cohort under-saving?
  - Or is NEW cohort over-saving?

- Introduction of Active Choice (Choi et al., 2004) – Large Fortune-500 Company, Financial sector

- Comparison between Active Choice (before) and No Enrollment (after)

- **Fact 3. Active Choice resembles Default Investment**

Table 1. 401(k) plan features by effective date

	Effective January 1, 1997	Effective November 23, 1997
Eligibility		
Eligible employees	U.S. employees, age 18+	U.S. employees, age 18+
First eligible	Immediately upon hire	Immediately upon hire
Employer match eligible	Immediately upon hire	Immediately upon hire
Enrollment	First 30 days of employment or January 1 of succeeding calendar years	Daily
Contributions		
Employee contributions	Up to 17% of compensation	Up to 17% of compensation
Non-discretionary employer match	50% of employee contribution up to 5% of compensation	50% of employee contribution up to 5% of compensation
Discretionary employer match	Up to 100% of employee contribution depending on company profitability (50% for bonus-eligible employees); 100% in 1997.	Up to 100% of employee contribution depending on company profitability (50% for bonus-eligible employees); varied from 0% to 100% for 1997-2000.[a]
Vesting	Immediate	Immediate
Other		
Loans	Not available	Available; 2 maximum
Hardship withdrawals	Available	Available
Investment choices	6 options. Employer stock also available, but only for after-tax contributions.	8 options + employer stock (available for before- and after-tax contributions)

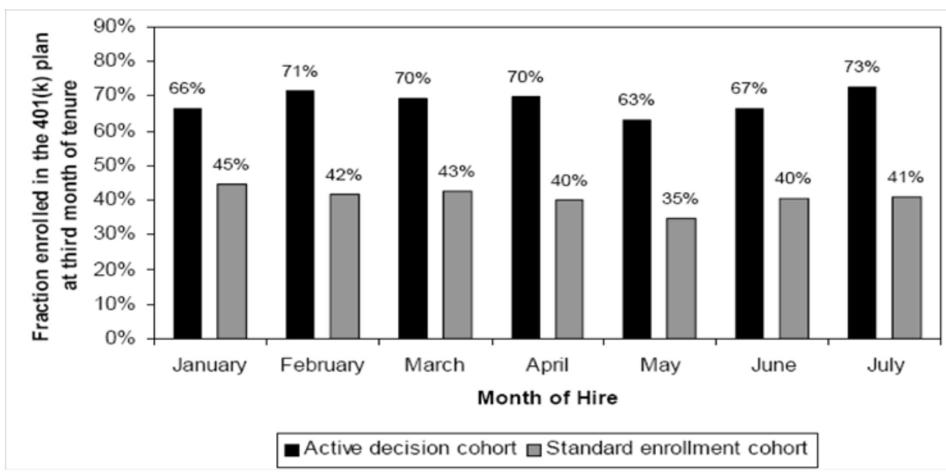
- ACTIVE Cohort, hired 1/1/97-7/31/97
  - 30 days to return 401(k) form with legal packet
  - Next enrollment period: January 1998
  - Paper-and-pencil form
- OLD2 Cohort, hired 1/1/98-7/31/98
  - Standard, no-saving-default (like OLD)
  - Can enroll any time
  - Telephone-based enrollment, 24/7

- Step 1. Check Design
  - Summary Stats (Table 2)–No substantial difference across cohorts

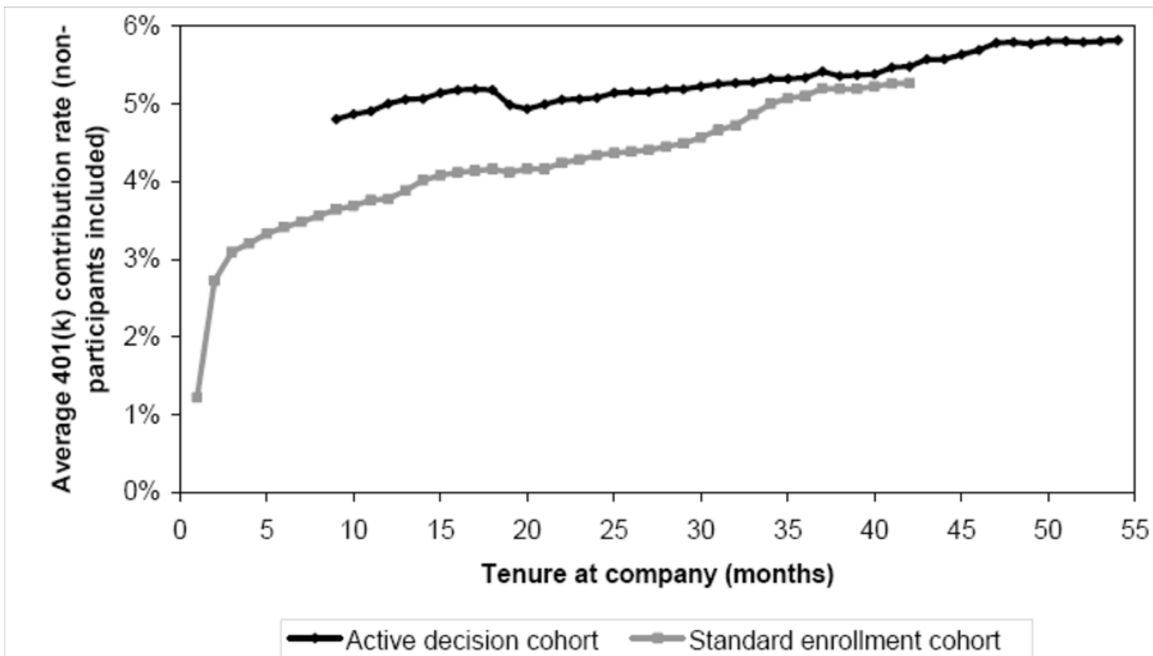
Table 2. Comparison of worker characteristics

	Study company			
	Active decision cohort on 12/31/98	Standard enroll. cohort on 12/31/99	All workers on 12/31/99	U.S. workforce (3/98 CPS)
Average age (years)	34.1	34.0	40.5	38.8
Gender				
Male	45.4%	43.4%	45.0%	53.1%
Female	54.6%	56.6%	55%	46.9
Marital Status				
Single	42.8%	47.8%	32.4%	39.0%
Married	57.2%	52.2%	67.6%	61.0%
Compensation				
Avg. monthly base pay	$2,994	$2,911	$4,550	--
Median monthly base pay	$2,648	$2,552	$3,750	--
Avg. annual income[a]	$34,656	$34,001	$52,936	$32,414
Median annual income[a]	$30,530	$29,950	$42,100	$24,108

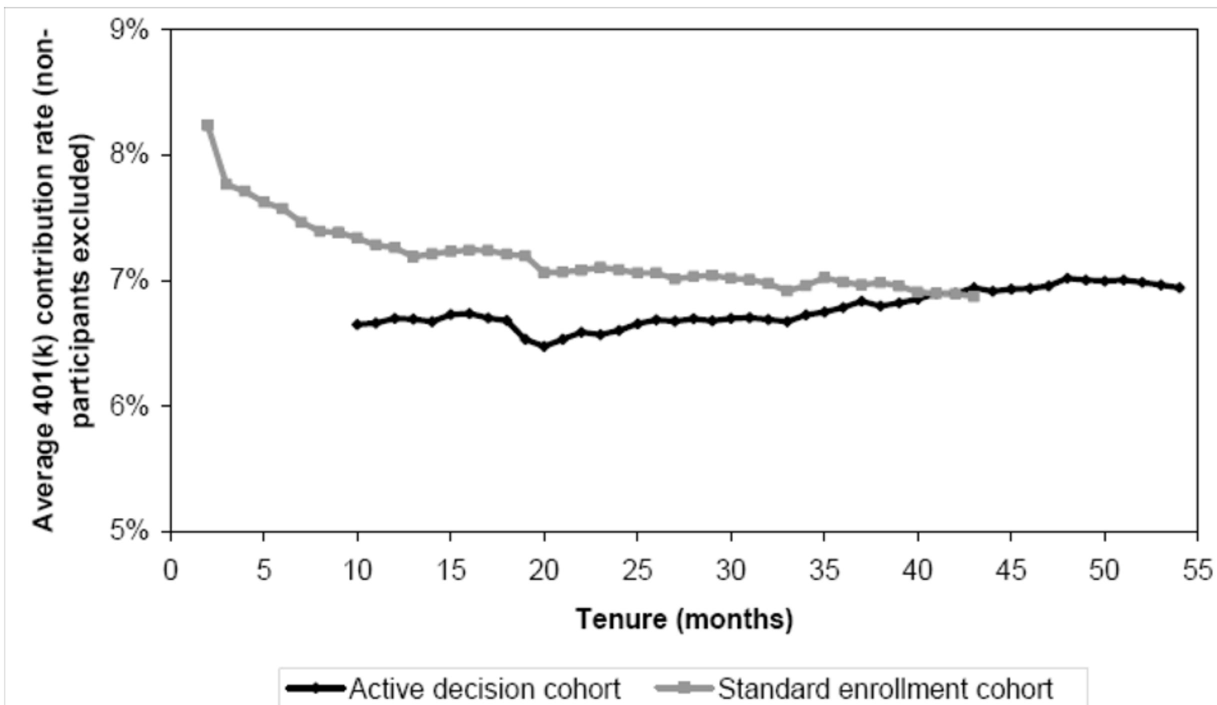
- Step 2. Compare plan choices (Figures 1 and 2)
  - *Participation* rates in 401(k) using cross-sectional data (Figure 1):
    - ACTIVE: 69% – OLD2: 41% (at month 3)
    - Compare to NEW (86%) and OLD (57%) in MS01 after >6 months
    - Does not depend on month of hire (see below)



- – *Contribution* rates (including zeros) (Figure 3)
    - ∗ ACTIVE: 4.8% – OLD2: 3.5% (at month 9, when longitudinal date becomes available)

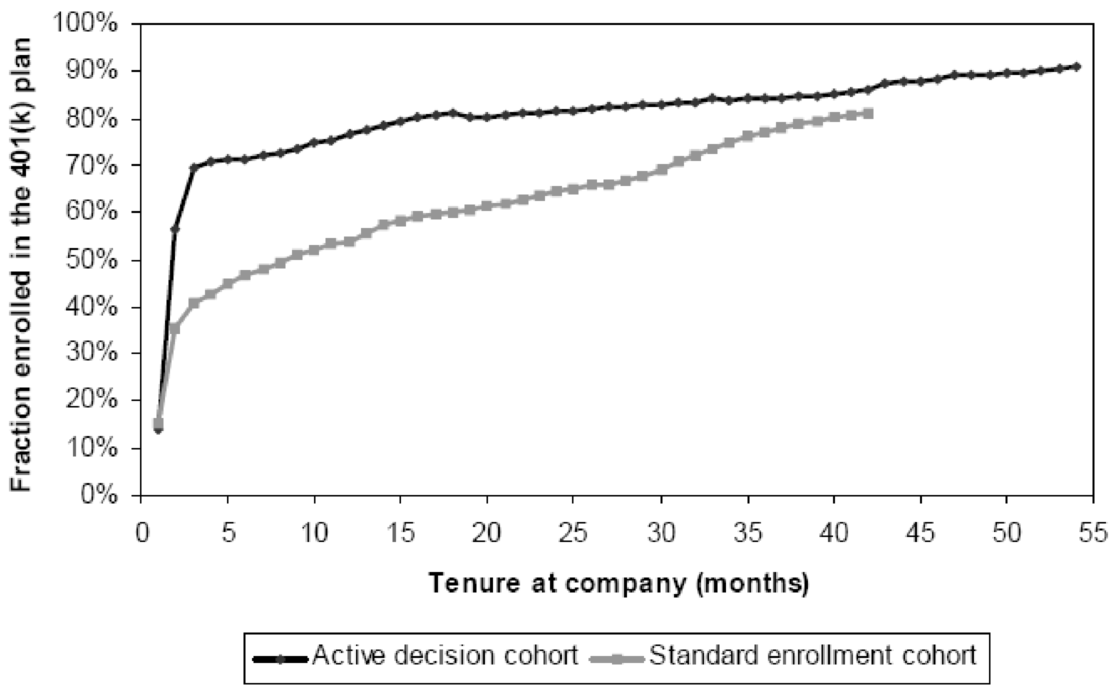


- – *Contribution* rates (excluding zeros) (Figure 4)
  - ∗ ACTIVE: 6.8% – OLD2: 7.5% (at month 9)
  - ∗ Selection effect: Marginal individuals are lower savers



- – Differences between ACTIVE and OLD2 disappear by year 3 (Figure 2)

  – Still: Important because no catch-up in levels, and because of frequent changes in employers



- Summary.
  - ACTIVE is close to NEW and differs from OLD and OLD2
    - **Fact 3. Active Choice resembles Default Investment**
    - Fact 3b. Month of Hire does not matter
  - **Fact 4. Effect of default mostly disappears after three years**
- Prevalence of OLD Default can (at least in part) explain under-saving for retirement

- Other evidence on default effects in 401(k) choice: Cronqvist and Thaler (2004, AER P&P)
  - Privatization of Social Security in Sweden in 2000
  - 456 funds, 1 default fund (chosen by government)
  - Year 2000:
    - Choice of default is discouraged with massive marketing campaign.
    - Among new participants, 43.3 percent chooses default
  - Year 2003:
    - End of marketing campaign.
    - Among new participants, 91.6 percent chooses default

- Related studies on 401(k) savings (later in class):

  1. SMRT plan (Benartzi and Thaler, JPE 2004)

     – Offer choice of future default (similar to Active Choice) to help people save

     – Spectacular results

  2. Financial education does not do much (Duflo and Saez, QJE 2001)

     – Easy to get people to attend a retirement fair with $10 prize

     – Very small effect on actual savings

     – Default effects loom very large relative to other determinants of savings

2 Default effects and Present Bias

- Above: Default effects in 401(k) savings decisions

- But also in:

  - Contractual choice in health clubs (DellaVigna and Malmendier, 2006) and credit cards (Ausubel, 1999)

  - Organ donations (Johnson and Goldstein, 2003; Abadie and Gay, 2004)

  - Car insurance plan choice (Johnson et al, 1993)

  - Car option purchases (Park, Yun, and MacInnis, 2000)

  - Consent to e-mail marketing (Johnson, Bellman and Lohse, 2003)

- How do we explain it? **Present-bias ((quasi-) hyperbolic discounting – (β, δ) preferences)**:

$$U_t = u_t + \beta \sum_{s=1}^{\infty} \delta^s u_{t+s}$$

with $\beta \leq 1$. Discount function: $1,\ \beta\delta,\ \beta\delta^2, \ldots$

1. **Time inconsistency.** Discount factor for self t is

   - $\beta\delta$ between t and $t+1 \Longrightarrow$ short-run impatience;

   - δ between $t+1$ and $t+2 \Longrightarrow$ long-run patience.

2. **Naiveté about time inconsistency**

   - Agent believes future discount function is $1,\ \hat{\beta}\delta,\ \hat{\beta}\delta^2$,...,with $\hat{\beta} \geq \beta$.

Non-Automatic Enrollment (OLD Cohort in Madrian-Shea, 2001)

- Setup of O'Donoghue and Rabin (2001): One-time decision (investment)
  - immediate (deterministic) cost $k_N > 0$ with $k_N = k'_N + k''_N$:
    - $k'_N > 0$ – effort of filling up forms
    - $k''_N > 0$ – effort of finding out optimal plan
  - delayed (deterministic) benefit $b > 0$
  - $T = 1$ (can change investment every day)
- When does investment take place?

- **Exponential** employee ($\beta = \hat{\beta} = 1$):

- Compares investing now to never investing:

$$-k_N + \sum_{t=1}^{\infty} \delta^t b = -k_N + \frac{\delta b}{1-\delta} \geq 0$$

- Invests if

$$k_N \leq \frac{\delta b}{1-\delta}$$

- **Sophisticated** present-biased employee ($\beta = \hat{\beta} < 1$):
  - Would like to invest tomorrow if:

$$\beta\delta\left[-k_N + \frac{\delta b}{1-\delta}\right] \geq 0$$

  - Would like to invest now if:

$$-k_N + \beta\delta\frac{b}{1-\delta} \geq 0$$

- War of attrition between selves
- Multiple equilibria in the investing period: Invest every τ periods
- Example for $\tau = 3$. List strategies to Invest (I) and Not Invest (N) over the time periods $0, 1, 2, 3$, etc.. Set of equilibria:
  - (I, N, N, I, N, N, I, N, N,...) –> Invest at $t = 0$
  - (N, N, I, N, N, I, N, N, I,...) –> Invest at $t = 2$
  - (N, I, N, N, I, N, N, I, N,...) –> Invest at $t = 1$
- There is no equilibria such that agent delays more than 2 periods

- *Bound on delay in investment.*
  - Agent prefers investing now to waiting for T periods if

$$-k_N + \beta\delta\frac{b}{1-\delta} \geq \beta\delta^T\left[-k_N + \frac{\delta b}{1-\delta}\right]$$

  - Simplify to

$$k_N \leq \beta\delta\frac{b\left(1-\delta^T\right)}{(1-\delta)\left(1-\beta\delta^T\right)} \approx \frac{\beta\delta b}{\left(1-\beta\delta^T\right)}T \approx \frac{\beta b}{1-\beta}T$$

    [Taylor expansion of $1-\delta^T$ for δ going to 1: $0-T\left(\delta-1\right)=\left(1-\delta\right)T$]

  - Maximum delay $\bar{T}$:

$$\bar{T} = k_N\frac{1-\beta}{\beta b}$$

- (Fully) **Naive** present-biased employee ($\beta < \hat{\beta} = 1$)
  - Compares investment today or at the next occasion (in T days).
  - Expects to invest next period if

$$-k_N + \frac{\delta b}{1-\delta} \geq 0$$

  - Invest today if

$$-k_N + \beta\delta\frac{b}{1-\delta} \geq \beta\delta^T \left[-k_N + \frac{\delta b}{1-\delta}\right]$$

  - Procrastinate forever if

$$\frac{\beta b T}{1-\beta} \lessapprox k_N \leq \frac{\delta b}{1-\delta}$$

- **Calibration**

- Cost k_N?

  - Time cost: 3 hours

  - $k_N \approx 3 * \$12 = \$36$

- Benefit b?

  - Consume today ($t = T_0$) with tax rate τ_0, or at retirement ($t = T_R$) with tax rate τ_R

  - Compare utility at T_0 and at T_R:

* Spend S additional dollars at T_0: $U'(C_0) * (1-\tau_0)$

* Save, get firm match α, and spend S dollars at T_R: $\delta^{T_R - T_0} U'(C_R) * (1+r)^{T_R - T_0}(1-\tau_R)(1+\alpha) S$

- Assumptions: $U'(C_0) = U'(C_R)$ and $\delta = 1/(1+r)$

- b is net utility gain from delayed consumption of S:

$$\begin{aligned} b &= \left[[\delta(1+r)]^{T_R - T_0}(1-\tau_R)(1+\alpha) - (1-\tau_0) \right] S = \\ &= [\tau_0 + \alpha - \tau_R(1+\alpha)] S \end{aligned}$$

- Calibration to Madrian and Shea (2001): 50 percent match ($\alpha = .5$), taxes $\tau_0 = .3$ and $\tau_R = .2$, saving $S = \$5$ (6% out of daily $w = \$83$ (median individual income $\approx$ \$30,000))

- $b \approx [.3 + .5 - .2 * (1.5)] S = .5S = \$2.5$

- Comparative statics:
  * What happens if $\alpha = 0$?
  * What happens is marginal utility at retirement is 10 percent higher than at present? (because of drop of consumption at retirement)
  * Effect of higher earnings S?

- What does model predict for different types of agents?

- **Exponential** agent invests if

$$k_N \leq \frac{\delta b}{1-\delta}$$

  - For $\delta^{365} = .97, \delta b/(1-\delta) = 10,000 * b$
  - For $\delta^{365} = .9, \delta b/(1-\delta) = 3,464 * b$
  - Invest immediately!
  - Effect of k is dwarfed by effect of b

- **Sophisticated** maximum delay in days:

$$\bar{T} = k_N \frac{1-\beta}{\beta b}$$

  - For $\beta = 1$, $\bar{T} = 0$ days
  - For $\beta = .9$, $\bar{T} = 36/(9 * 2.5) \approx 2$ days
  - For $\beta = .8$, $\bar{T} = 36/(4 * 2.5) \approx 4$ days
  - For $\beta = .5$, $\bar{T} = 36/2.5 \approx 14$ days

  - Sophisticated waits at most a dozen of days
  - Limited effect of k on timing of investment

- **(Fully) Naive** t.i. with $\beta = .8$ invests if

$$k_N \lessapprox \frac{\beta T b}{(1-\beta)}$$

  - For $T = 1$ (I'll do it tomorrow), investment if $36 < 2.5 * \beta / (1 - \beta)$
    - $\beta = .8$ (or .5) $->$Procrastination since $36 > 2.5 * 4$ (or $36 > 2.5$)
  - For $T = 7$ (I'll do it next week), investment if $36 < 5.6 * \beta / (1 - \beta)$
    - $\beta = .8$ $->$Investment since $36 < 7 * 2.5 * 4$
    - $\beta = .5$ $->$Procrastination since $36 > 7 * 2.5$
  - Relatively small cost k can induce infinite delay (procrastination)
  - Procrastination more likely if agent can change allocation every day

Automatic Enrollment (NEW Cohort in Madrian-Shea, 2001)

- Model:
  - $k'_A < 0$ – not-enrolling requires effort
  - $k''_A = 0$? – do not look for optimal plan
  - $k_A = k'_A + k''_A < 0$
  - $T = 1$ (can enroll any day)
- Exp., Soph., and Naive invest immediately (as long as $b > 0$)
- No delay since investing has no immediate costs (and has delayed benefits)

- **Fact 1. Most investors follow Default Plan**

- Exponentials and Sophisticates –> Should invest under either default

- Naives –> Invest under NEW, procrastinate under OLD

- Evidence of default effects consistent with naivete'

- (Although naivete' predicts procrastination forever – need to introduce stochastic costs)

- Can b be negative?
- It can: liquidity-constrained agent not interested in saving
- (consumption-savings decision not modeled here)
- $b < 0$ for at least 14% of workers (NEW: 86% participate).

- Is there too much 401(k) investment with automatic enrollment?
- With $T = 1$ and $k_A < 0$, naive guys may invest even if $b < 0$.

Active Choice (ACTIVE Cohort)

- Model:
  - $k'_C = 0$ – not-enrolling requires effort
  - $k''_C > 0$? – harder to guess optimal plan than to set 0 investment
  - $k_C = k'_C + k''_C > 0$ (but smaller than before) or $k_C = 0$
  - [$T = 360$ under ACTIVE]

- Predictions:
  - Exponentials and Sophisticates:
    - Predicted enrollment: OLD2$\simeq$OLD$\simeq$ACTIVE$\simeq$NEW
  - Naives:
    - $0 < k_C < k_A$ –> Predicted enrollment: OLD2=OLD<<ACTIVE$\leq$NEW
    - [Move from $T = 360$ (ACTIVE) to $T = 1$ (OLD2) –> Predicted enrollment: OLD=OLD2<ACTIVE

- **Fact 3. Active Choice resembles Default Investment (**OLD<<ACTIVE$\simeq$NEW)

- Findings consistent with naivete'

- **Fact 4. Effect of default mostly disappears after three years**

- Problem for naivete' with model above: delay *forever*

- Introduce Stochastic cancellation costs $k \sim K$ –> Dynamic programming

- Solution for **exponential** agent. Threshold k^e:

  – enroll if $k \leq k^e$;

  – wait otherwise.

- For $k = k^e$ indifference between investing and not:

$$-k^e + \frac{\delta b}{1-\delta} = \delta V^e(k^e)$$

where $V^e(k^e)$ is continuation payoff for exponential agent assuming that threshold rule k^e is used in the future.

- Threshold k^n for **naive** agent satisfies:

$$-k^n + \beta\frac{\delta b}{1-\delta} = \beta\delta V^e(k^e)$$

- This implies $k^n = \beta k^e$
  - –> Investment probability of exponential agent: $\Pr(k \leq k^e)$
  - –> Investment probability of naive agent: $\Pr(k \leq \beta k^e)$

3 Default Effects: Alternative explanations

- A list of alternative explanations:

1. Rational stories

   (a) Time effect between 1998 and 1999 / Change is endogenous

   (b) Cost of investing is high (HR staff unfriendly) –> Switch investment elsewhere

   (c) Selection effect (People choose this firm because of default)

2. Bounded Rationality. Problem is too hard

3. Persuasion. Implicit suggestion of firm

4. Memory. Individuals forget that they should invest

5. Reference point and loss aversion relative to firm-chosen status-quo

- Some responses to the explanations above:

1. Rational stories

   (a) Time effect between 1998 and 1999 / Change is endogenous (political economy)

   - Replicates in Choi et al. (2004) for 4 other firms

   (b) Cost of choosing plan is comparatively high (HR staff unfriendly) –> Switch investment elsewhere

   (c) Selection effect (People choose this firm because of default)

   - Why choose a firm with default at 3%?

2. Bounded Rationality: Problem is too hard

   - In surveys employees say they would like to save more

   - Replicate where can measure losses more directly (health club data)

3. Persuasion. Implicit suggestion of firm

   - Why should individuals trust firms?

   - **Fact 2.** Window cohort does not resemble New cohort

4. Memory. Individuals forget that they should invest
   - If individuals are aware of this, they should absolutely invest before they forget!
   - Need limited memory + naiveté

5. Reference point and loss aversion relative to firm-chosen status-quo
   - First couple month people get used to current consumption level
   - Under NonAut., employees unwilling to cut consumption
   - BUT: Why wait for couple of months to chose?

4 Present-Bias and Consumption

- Consider an agent that at time 1 can choose:
  - A consumption activity A with immediate payoff b_1 and delayed payoff (next period) b_2
  - An outside option O with payoff 0 in both periods

- Activity can be:
  - Investment good (exercise, do homework): $b_1 < 0, b_2 > 0$
  - Leisure good (borrow and spend, smoke cigarette): $b_1 > 0, b_2 < 0$

- How is consumption decision impacted by present-bias and naiveté?

- **Desired consumption.** A time 0, agent wishes to consume A at $t = 1$ if

$$\beta\delta b_1 + \beta\delta^2 b_2 \geq 0 \text{ or } b_1 + \delta b_2 \geq 0$$

- **Actual consumption.** A time 1, agent consumes A if

$$b_1 + \beta\delta b_2 \geq 0$$

- *Self-control problem* (if $\beta < 1$):
  - Agent under-consumes investment goods ($b_2 > 0$)
  - Agent over-consumes leisure goods ($b_2 < 0$)

- **Forecasted consumption.** As of time 0, agent expects to consumer A if

$$b_1 + \hat{\beta}\delta b_2 \geq 0.$$

- *Naiveté* (if $\beta < \hat{\beta}$):
  - Agent over-estimates consumption of investment goods ($b_2 > 0$)
  - Agent under-estimates consumption of leisure goods ($b_2 < 0$)

- Implications:
  - Sophisticated agent will look for commitment devices to align desired and actual consumption
  - Naive agent will mispredict future consumption

- Present evidence on these predictions for:

  1. Investment Goods:

     - Homeworks and Task Completion (Ariely and Werternbroch, 2002)

     - Exercize (DellaVigna and Malmendier, 2006)

  2. Leisure Goods:

     - Credit Card Usage (Ausubel, 1999; Shui and Ausubel, 2005)

     - Consumption (Laibson, Repetto, and Tobacman, 2006)

5 Investment Goods: Homeworks

- Wertenbroch-Ariely, “Procrastination, Deadlines, and Performance", *Psychological Science,* 2002.

- Experiment 1 in classroom:

  - sophisticated people: executives at MIT;

  - high incentives: no reimbursement of fees if fail class

  - submission of 3 papers, 1% grade penalty for late submission

- Two groups:
  - Group A: evenly-spaced deadlines
  - Group B: set-own deadlines
- Deadline setting for Group B: close to end (Exp. or Naive, not Soph.)

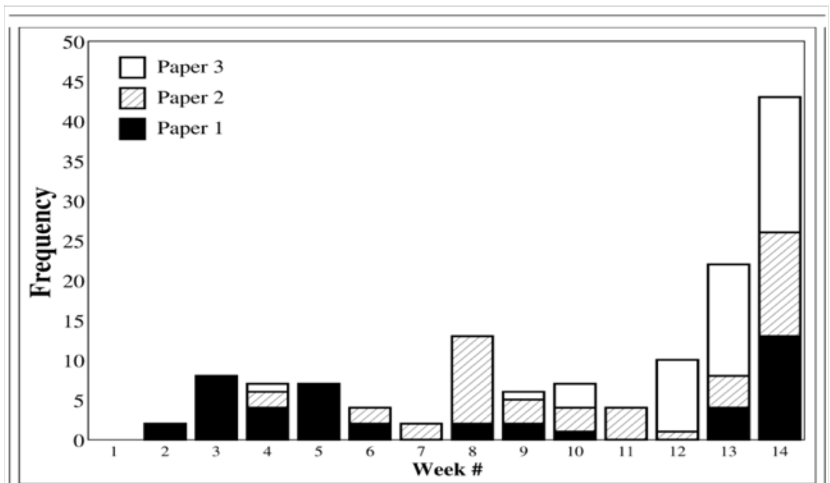


Fig. 1. Frequency distribution of the declared deadlines in Study 1 as a function of the week of class (Week 1 is the first week, and Week 14 the last week), plotted separately for the three papers.

- Results on completion and grades:
  - No late submissions (!)
  - Papers: Grades in Group A (88.7) higher than grades in Group B (85.67)
  - Consistent with self-control problems

- Experiment 2. Proofreading exercise.
  - Group A: evenly-spaced deadlines
  - Group B: no deadlines
  - Group C: self-imposed deadlines

- Predictions:
  - Standard Theory: $B = C > A$
  - Sophisticated Present-Biase (demand for commitment): $C > A > B$
  - Fully Naive Present-Biased: $A > B = C$
  - Partially Naive Present-Biased: $A > C > B$

- Results on Performance: $A > C > B$

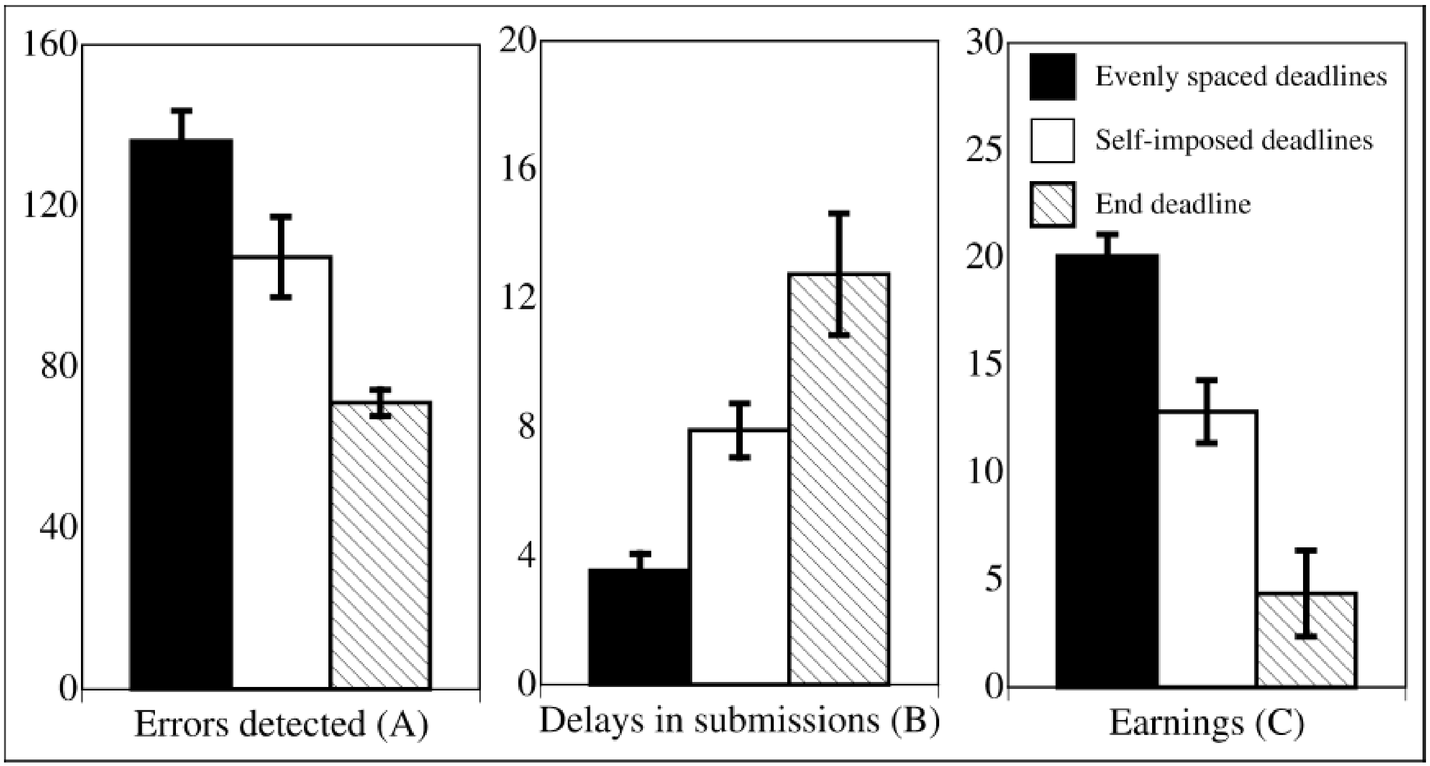


Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.

6 Next Week

- 12-1: Meet in 2232 Piedmont in Demography Seminar Room for brownbag workshop with Danny Kahneman on behavioral economics and demography

- Topics to think about:

  - Do people make the decision to have kids optimally? (procrastination/overconfidence...)

  - ...

- Send me an email with any thoughts you have by Monday

- Class starts at 1.10pm

- Investment Goods:

  - Exercize (DellaVigna and Malmendier, 2006)

- Leisure Goods:

  - Credit Card Usage (Ausubel, 1999; Shui and Ausubel, 2005)

  - Consumption (Laibson, Repetto, and Tobacman, 2006)

  - Quick summary of other applications